

Potentiometric Surface of the Alluvial Aquifer and Hydrologic Conditions at the Río Nigua de Salinas Alluvial Fan, Salinas, Puerto Rico, July 9-11, 2002

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A synoptic survey of the hydrologic conditions in the Río Nigua de Salinas alluvial fan was conducted from July 9 to 11, 2002, to define the spatial distribution of the potentiometric surface. The survey was part of a major study to assess the ground-water quality in the Río Nigua de Salinas alluvial aquifer. The Río Nigua de Salinas alluvial fan covers approximately 9,000 acres of the more extensive South Coastal Plain Alluvial Aquifer system and is bounded along the north by foothills of the Cordillera Central mountain chain and to the south by the Caribbean Sea. Ground-water flow occurs primarily within alluvial deposits that increase in thickness toward the coast to as much as 400 feet near the center of the study area, but is highly irregular along its east-to-west extensions (Quiñones-Aponte and others, 1997). Fresh ground water in the aquifer occurs under semi-confined conditions along the coast to a distance of as much as 2 miles inland and under unconfined conditions throughout both the alluvial deposits and underlying weathered rock at areas farther inland (Quiñones-Aponte and Gómez-Gómez, 1987). The potentiometric surface was delineated using ground-water level measurements made at existing wells. Ground-water levels measurements were made at wells that were not pumping during the survey or wells that were turned off. For the latter, a recovery period of 30 minutes was allowed for the ground-water level to achieve a near static level position. Land-surface altitude from the U.S. Geological Survey (USGS) 1:20,000 scale topographic maps (Cayey, Coamo, Central Aguirre, and Salinas) were used to refer ground-water levels to mean sea level datum.

The survey was conducted during a period of relatively stable hydrologic conditions (near steady-state conditions) and included measurement of ground-water levels in 57 wells, instantaneous discharge measurements at 9 locations in streams and irrigation canals, and estimates of ground-water withdrawals at 30 active, large production wells. Precipitation in the area, as indicated at the Aguirre Central National Weather Service rainfall observation station 660152 prior to the survey between January 1, 2002, to July 8, 2002, totaled 17.7 inches (fig. 1). The station data indicate that between July 1 and 8, 2002, a total of 3.18 inches of rainfall was recorded. Observation wells in the area, however, indicate there was no change in the declining water-level trends after the July 7, 2002, rain events (fig. 2).

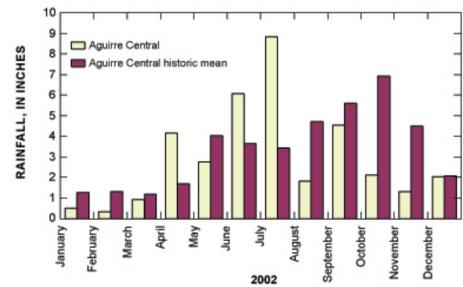


Figure 1. Rainfall at the Aguirre Central National Weather Service station (660152) Salinas, Puerto Rico.

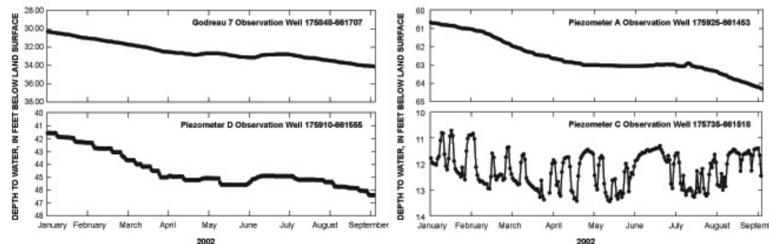


Figure 2. Ground-water levels in selected U.S. Geological Survey observation wells in the Río Nigua de Salinas alluvial fan, Salinas, Puerto Rico.

The general direction of the ground-water flow is indicated on this map by flow lines drawn perpendicular to the potentiometric surface contours. As shown by the flow lines, the general direction of the ground-water flow in the aquifer is to the south in areas inland of highway PR-3. Ground-water levels indicate that a cone of depression was present over an area of approximately 850 acres south of highway PR-3, ranging from sea level to 25 feet below sea level. The cone of depression indicates that ground-water flow was inland throughout most of the aquifer in the area to the south of highway PR-3 and between longitude 66°16'52" W, on the west and Central Aguirre on the east, indicating a great potential for seawater intrusion in this area. Water-quality samples collected during 2002 at active wells within the cone of depression, however, had dissolved solid concentrations between 500 and 650 milligrams per liter. Ground-water levels at four USGS observation wells in the area indicate there has been a declining trend since 1999 with levels at their lowest since 1998 (fig. 3). Thus, the cone of depression shown may have been developed over a period of several years prior to July 2002. A smaller cone of depression was inferred from the potentiometric map in the northeast quadrant of the Salinas fan.

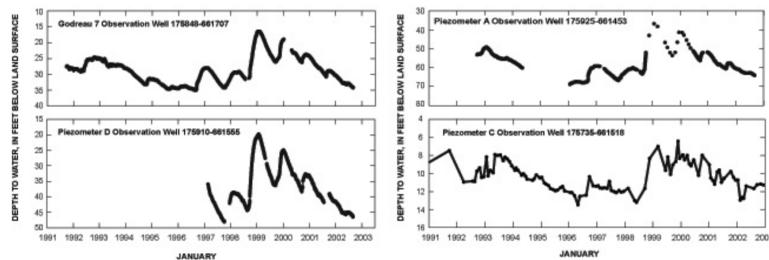
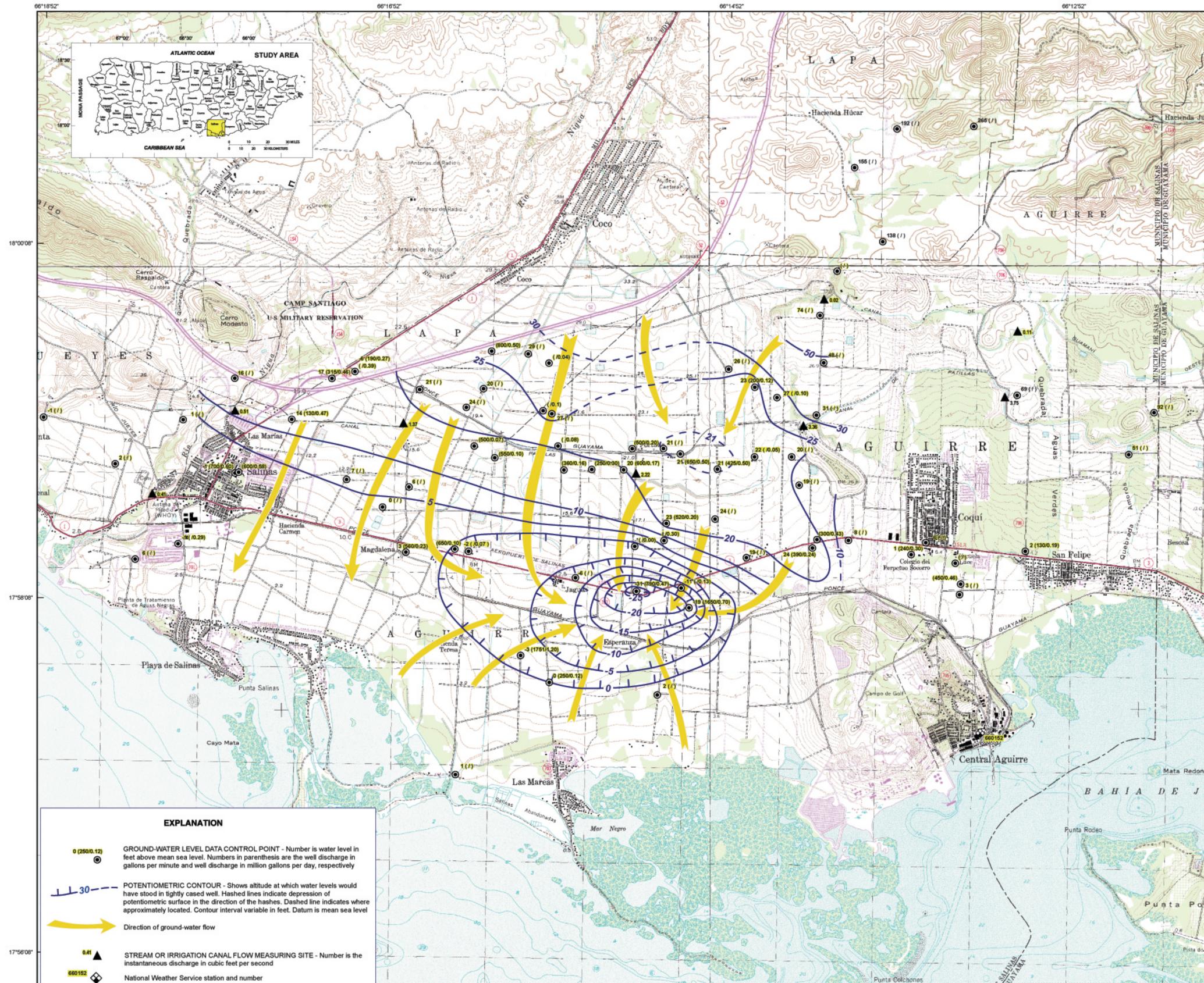


Figure 3. Long term ground-water levels in selected U.S. Geological Survey observation wells in the Río Nigua de Salinas alluvial fan, Salinas, Puerto Rico.

Ground-water withdrawals in the area were estimated on the basis of observations (well-discharge meter readings and interviews with farmers) obtained during several months prior to July 2002. Total ground-water withdrawals in the study area were estimated at approximately 11.4 million gallons per day (Mgal/d). Ground-water withdrawals were primarily for agricultural use (6.3 Mgal/d), public supply (4.1 Mgal/d), and industrial use (1.0 Mgal/d).

Instantaneous surface-water discharge measurements were made at selected sites along the Río Nigua, the Canal de Patillas, and the Canal de Guamaní (map), to put in perspective the hydrologic conditions during the synoptic survey. The instantaneous discharge measurements made on July 9, 2002, in the Canal de Patillas indicate a flow rate of 3.75 cubic feet per second (ft³/s) at the eastern limit of the study area and 0.51 ft³/s near the point where the canal discharges to the Río Nigua. The instantaneous discharge measurements in the Canal de Guamaní indicate a flow rate of 0.11 ft³/s at the eastern limit of the study area and 0.02 ft³/s near the center of the study area. The difference in flow between each set of measurements at the irrigation canals may be caused by infiltration loss and diversion for irrigation. The instantaneous discharges measured in the Río Nigua were 0.17 ft³/s at the upstream discharge measurement point at Barrio Coco (located approximately 0.74 mile upstream from the northern limit of the map) and 0.41 ft³/s at highway PR-3 near the coast.

REFERENCES



EXPLANATION

- GROUND-WATER LEVEL DATA CONTROL POINT** - Number is water level in feet above mean sea level. Numbers in parenthesis are the well discharge in gallons per minute and well discharge in million gallons per day, respectively
- POTENTIOMETRIC CONTOUR** - Shows altitude at which water levels would have stood in tightly cased well. Hashed lines indicate depression of potentiometric surface in the direction of the hashes. Dashed line indicates where approximately located. Contour interval variable in feet. Datum is mean sea level
- Direction of ground-water flow**
- STREAM OR IRRIGATION CANAL FLOW MEASURING SITE** - Number is the instantaneous discharge in cubic feet per second
- National Weather Service station and number**